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## High Efficiency, High Density, PolyPhase Converters for High Applications

Wei Chen

### Introduction

As logic systems get larger and more complex, their supply current requirements are increasing. Systems requiring 100A are fairly common. A high current power supply to meet these requirements usually requires paralleling several power regulators to alleviate the individual power components. A power supply designer is left with the choice of these paralleled regulators: brute-force single-phase or smart PolyPhase™. PolyPhase interleaves the clock signals of the paralleled power stages, reducing input current without increasing the switching frequency. The decreased power loss allows for a smaller input capacitor and the low switching losses associated with MOSFETs at high frequencies help achieve high power conversion efficiency. The size and cost of electrolytic capacitors are also greatly reduced as a result of input ripple current cancellation. Input ripple current cancellation also occurs, lower value inductors can be used. The improved dynamic response to load transients. A combination of lower current rating inductors also allows the use of smaller-sized, low profile, surface mount components. In multioutput applications, PolyPhase converters may also provide the benefits of smaller capacitors.

Previously, the implementation of multiphase designs was difficult and expensive due to complex timing and current-sharing requirements. The newly developed LTC1628 and LTC1629 address these problems for high current, single output designs, while the LTC1628 addresses multioutput applications. Both ICs are dual, current mode, PolyPhase controllers that can drive multiple synchronous buck stages simultaneously. The features of the LTC1629 include a differential amplifier for true remote sensing, low impedance gate drives, current limit, overvoltage protection, optional overcurrent latch-off and foldback current limit. The LTC1629 can be configured for 2-, 3-, 4-, 6- and 12-phase operation with a single input signal (high, low or open). Optimizing the number of phases can help achieve the most cost-effective power supply design.

This application note analyzes the performance of PolyPhase converters and provides guidelines for selecting the phase number and designing a PolyPhase converter using 1. The following questions will be answered as the discussion goes on:

- How much do I gain by using a PolyPhase architecture?
- How many phases do I need for my application?
- How do I design a PolyPhase converter?

### How Do Polyphase Techniques Effect Circuit Performance?

In general, PolyPhase operation improves the large signal performance of a converter, by such means as reducing ripple current and ripple voltage. A synchronous converter is used as an example in this application note to analyze the effect of these techniques on circuit performance.

High current outputs usually require paralleling several regulators. This is not feasible because of the unacceptable thermal stress on the individual power MOSFETs. Paralleled regulators are synchronized to have the same switching frequency to reduce frequency noise at both the input and output terminals. Based on the phase shift of the paralleled regulators, the paralleling technique can be used to reduce the ripple current and voltage.

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